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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/893,577	06/29/2001	Masahiro Tadokoro	501.40201X00	5596

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EXAMINER

CHEN, KIN CHAN

ART UNIT PAPER NUMBER

1765

DATE MAILED: 01/13/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/893,577

Applicant(s)

TADOKORO ET AL.

Examiner

Kin-Chan Chen

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-40 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-40 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2. 6) ☐ Other: _____

DETAILED ACTION

Claim Objections

1. Claim 13 is objected to because of the following informalities:

In claim 13, line 1, the examiner suggests replace "the" with --a--.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamada et al. (US 6,159,862; hereinafter "Yamada").

In reference to claims 1, 9-11, 18-22, 28-30, 37-40, Yamada teaches that a silicon nitride insulating film may be deposited on a semiconductor substrate. A silicon oxide insulating film may be deposited on the silicon nitride insulating film (or on a semiconductor substrate). A hard mask may be formed on the silicon oxide insulating film. See col. 7, lines 30-59; Fig. 2. The semiconductor substrate may be subjected to a plasma etching treatment through the hard mask as an etching mask using an etching gas containing C₅F₈ (or fluorocarbon), oxygen, and a dilution gas (e.g., Ar) to process

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the silicon oxide insulating film. During the process, the etching gas has been fed into the treatment chamber and a high-density plasma is excited (so-called plasma density ranges from 1×10^{10} to 1×10^{12} /cm³ (or 1×10^{13} cm³) in instant claims 9, 10, 28, and 29). See col. 8, lines 16.

Yamada does not disclose the residence time of the etching gas that is used in its process. The instant claims differ from Yamada by specifying various residence time of the etching gas (such as 50-700 ms in claims 1 and 22, 50-350 ms in claims 18 and 37, 100-200 ms in claims 19 and 38). However, it would have been obvious to one of ordinary skilled in the art to determine the suitable residence time through routine experimentation to obtain the best etched product achievable because the skilled artisan understands that the residence time is directly related to the amount of reactive gas dissociation occurring in the plasma, the longer a gas molecule remains exposed to a plasma, the more likely it is that dissociation of the gas molecule will continue. See evidences in Liu et al. (US 6,403,491), Collins et al. (US 6,238,588 B1), Jeng et al. (US 5,282,925), and Toprac et al. (US 6,238,937) in the record.

In reference to claims 2, 5, 16, 17, 20, 21, 23, 26, 35, 36, 39, and 40. Yamada teaches that the pressure within the etching chamber may be 30 mTorr (col. 11, line 12). The instant claims differ from Yamada by specifying various pressures (or partial pressures of C₅F₈) within the etching chamber (such as 0.7 to 7 Pa in claims 2, 20, 23, and 39; 1.3 to 4 pa in claims 5, 21, 26 and 40; 0.02 to 0.2 Pa of C₅F₈ in claims 16 and 35; 0.04 to 0.1 pa of C₅F₈ in claims 17 and 36). Yamada teaches examples of the process variables including pressure (col. 8, lines 1-16), and discloses that the process variables

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may be changed for different etching results (col. 8, lines 42-47). Since pressure (pressure or partial pressure of each gas) in the chamber is known to be result-effective variable, it would have been obvious to one of ordinary skilled in the art to determine the optimum, operable range in order to produce the best etched product achievable.

In reference to claims 3-6, 12, 13, 21, 24-27, 31-33, 39 and 40, Yamada teaches that that total flow rate of the etching gas may be at $780 \text{ cm}^3 / \text{minute}$ (col. 5, line 64), which is within the range cited. The flow rate of dilution gas is larger than the flow rates of the fluorocarbon gas and oxygen (instant claims 6 and 27). The instant claim 20 differs from the Yamada by specifying $700 \text{ cm}^3 / \text{minute}$. Since the flow rate of Yamada is close enough that one skilled in the art would have been expected to have the same properties.

As to claims 14, 15, 33 and 34, Yamada teaches the ratio of the flow rate between the oxygen and C_5F_8 (col. 5, line 48).


As to dependent claims 7 and 8, Yamada teaches that the temperature at the inner wall surface of the chamber may be 60°C and may be 40°C at lower electrode. Yamada does not disclose the temperature of the substrate being plasma etched in its process. The instant claims differ from Yamada by specifying the temperature of the substrate, however, the temperature of the substrate is commonly determined by routine experimentation. It would have been obvious to one of ordinary skilled in the art to optimize the temperature through the routine experimentation in order to produce an expected result.

Conclusion

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Liu et al. (US 6,403,491, col. 29), Collins et al. (US 6,238,588 B1, col. 2, lines 35-50), Jeng et al. (US 5,282,925, abstract), and Toprac et al. (US 6,238,937; col. 7, lines 25-25) teach controlling or adjusting residence time of etching gas in the etching process.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kin-Chan Chen whose telephone number is (703) 305-0222. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-2934.

K-C C
January 7, 2003


Patent Examiner
Group Art Unit 1765